

## Enhancing social inclusion through multisensory stimulation: improving fine motor skills in children with down syndrome

Aprimorando a inclusão social por meio da estimulação multissensorial: melhorando as habilidades motoras finas em crianças com síndrome de Down

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### ABSTRACT

**Background:** The purpose of the research was to improve fine motor skills in children, girls with Down Syndrome between 4 to 9 years of age. It aims at optimizing their activities of daily living and obtaining a certain degree of functional independence. **Objective:** The implementation of Multisensory Stimulation for fine motor skills in Down Syndrome. **Methods:** This research was descriptive, cross-sectional, quantitative. A Pre and Post evaluation was applied using the Graphomotor Test, the Denver Test, the Goddard Test and the Fine Motor Calculation. It was based on the Technical Guidelines for Down Syndrome care of the Ministry of Health of El Salvador. The execution of Multisensory Stimulation was carried out in the Snoezelen Rooms with their respective activities. **Results:** An improvement in fine motor skills was observed after the application of Multisensory Stimulation and the different activities in the Snoezelen Rooms. **Conclusions:** The investigation was verified by means of the Shapiro-Wilk test taking into account the degrees of freedom ( $p \geq 0.05$ )  $H_0$  was accepted, where Multisensory Stimulation does improve fine motor skills in Down Syndrome. It allows boys/girls to have a better grip on their thenar clamp, which facilitates the different daily activities.

**Keywords:** Social inclusion; Down Syndrome; Motor Skills; Perception; Sensation

### RESUMO

**Antecedentes:** O objetivo da pesquisa foi melhorar as habilidades motoras finas em crianças, meninas com Síndrome de Down entre 4 a 9 anos de idade. Visa otimizar suas atividades de vida diária e obter certo grau de independência funcional. **Objetivo:** A aplicação da Estimulação Multissensorial para motricidade fina na Síndrome de Down. **Métodos:** Esta pesquisa foi descritiva, transversal, quantitativa. Foi aplicada uma avaliação Pré e Pós por meio do Teste Grafomotor, Teste de Denver, Teste de Goddard e Cálculo Motor Fino. Foi baseado nas Diretrizes Técnicas para o atendimento da Síndrome de Down do Ministério da Saúde de El Salvador. A execução da Estimulação Multissensorial foi realizada nas Salas Snoezelen com suas respectivas atividades. **Resultados:** Observou-se uma melhora na motricidade fina após a aplicação da Estimulação Multissensorial e das diferentes atividades nas Salas Snoezelen. **Conclusões:** A investigação foi verificada por meio do teste de Shapiro-Wilk levando em consideração os graus de liberdade ( $p \geq 0,05$ )  $H_0$  foi aceito, onde a Estimulação Multissensorial melhora a motricidade fina na Síndrome de Down. Permite que os meninos/meninas tenham uma melhor aderência em sua pinça tenar, o que facilita as diferentes atividades diárias.

**Palavras-chave:** Inclusão social; Síndrome de Down; Destreza Motora; Percepção; Sensação.

### INTRODUCTION

Multisensory Stimulation (MS) plays an important role in the maturation of the different senses in children with certain types of limitations. This is possible through the active work of the senses and their relationship with the external

environment for which different MS rooms are used. (Carbajo,2015).

The development of the brain in the first years of life plays a very significant role in the integral development of the child. At this stage is when the most transcendental events of their maturation occur. The appropriate and timely motivation of their intellectual, language, motor, affective and social abilities is essential for infants to develop their different skills. (Quispe & Aronés,2014). In the Latin American context, there are still countless barriers to the advancement of inclusive education (Moncayo et al., 2024; Dos Santos, 2024).

Boys/girls with Down syndrome present several motor problems especially in the first months of life. The main condition is the late response to different sensory stimuli, causing a delay in their psychomotor development and alterations in developmental milestones. Individuals with this condition present a generalized muscular hypotonia, manifesting difficulty when crawling and taking different objects. All this occurs due to the presence of an alteration and damage in the genetic material at the level of the 21st pair. Fundamentally the child with Down syndrome is born with the presence of 47 chromosomes instead of 46 pairs. This alters their physical, mental and social characteristics (Azoulay, 2019).

The United Nations Organization (2019) referred that 1 in 1000 people worldwide are born with trisomy of the 21st pair accompanied by some degree of intellectual impairment. In Ecuador and according to the National Council for Equality of Disabilities (2022) it was noted that intellectual disability covers 23.12% nationally, with 30% - 40% of Down Syndrome cases. In the Province of Tungurahua, Ambato city, it represents 20.54% due to the high levels of poverty and discrimination in the surrounding parishes of the city. (National Council for Disability Equality -CONADIS, 2022).

Campos-Campos et al. (2021) based on the systematic review, carried out on early stimulation and motor development in Down syndrome in children, analyzed the constant stimulation of motor skills of children with this condition. It emphasizes the fundamental role of parents, teachers, as well as the surrounding environment and the different stimulation therapies that facilitated the development of fine and gross motor skills. It also highlights brain plasticity and its ability to redesign different structures to improve the different responses and achieve a change in motor development. The research analyzed the cases of children with DS who have an imbalance in their fine motor skills. The authors emphasize the application of different techniques and motivation methods to improve their condition. It is concluded that the use of Multisensory Stimulation is effective with people who have some type of disability. (Bergstrom et al., 2018)

Yépez et al. (2019) in the study on Down Syndrome and psychomotor development during the last five years, brought to light the correlation between motor development and psychomotor skills in children with Down syndrome, which are important for normal development, the execution of activities of daily living such as eating, taking objects, brushing teeth, among others. Similarly, the authors point out the development of fine motor skills that facilitate the correct use of a pencil, a garment with buttons, and the use of different kitchen utensils. The purpose of the systematic review was to establish a convenient relationship with Down syndrome and the presence of good psychomotor skills, which are responsible for defining a better quality of life for individuals who have DS. (Sanchez et al., 2022)

Toro (2019) studied the Multisensory Stimulation and Snoezelen Rooms, which are rooms redesigned and adapted with different materials to perform a successful intervention according to the needs of each person. The application of the Multisensory Stimulation therapy facilitated the progress of balance, motor skills and even memory without age limit. It facilitates their daily life, and helps to avoid falls in people with disabilities thanks to the progress of their psychomotor skills. The use of the Snoezelen Rooms is of great help when enhancing deficiencies with any type of disability and multidisability prototype. Within the research, a sample of thirty-five participants was taken using Multisensory Stimulation with the intervention of Snoezelen as a therapeutic method. It resulted in a significant change in balance and therefore in their motor skills, avoiding falls thanks to the intervention of MS. It presented changes in the motor skills of those involved. Apan-Araujo et al. (2020) pointed out in their research on Multisensory Stimulation and the role it plays on psychomotor skills in children; that stimulation is perceived through the different senses. The perception of information coming from the outside is processed by the brain to achieve better integration, significantly optimizing the relationship with the environment around us. The study was carried out on twelve children for ten days, twice a week with a duration of approximately one hour. The application of the McCarthy Scale was used, both at the beginning and at the end of the research. The results were that the application of an MS program helped to improve the development of fine and gross motor skills of children and therefore contributed with significant changes in their psychomotor skills, facilitating their activities in daily life. (Jan & Jarmila, 2021).

The objective of this research work consisted in highlighting the effect of Multisensory Stimulation and the role it plays in the improvement of fine motor skills in children with Down Syndrome from 4 to 9 years old. The current research helped to reinforce the development of the limitations presented by the participants. It favors the integration of sensory information and improves their learning. It also helps the relationship with the environment by providing an environment with controlled stimuli. Through this the child has the freedom to experiment and learn the management of their fine motor skills by observing. It was concluded that there is the need to develop a Multisensory Stimulation Guide to improve fine motor skills in Down Syndrome. (Jumbo et al., 2021).

## METHODS

The current research is descriptive. It was based on the different characteristics and realities. It presents a correct and real interpretation of the people, groups, and entities to be analyzed. It has a transversal or vertical cut. It was directed to a determined space and time, and according to the type of base information it was quantitative. And it focused on quantifying the different results by means of statistics.

This research was developed in the Specialized Educational Unit "Ambato", in a city with the same name in the Province of Tungurahua, Ecuador. The institution is home to about 250 children and adolescents with different disabilities and multidisabilities such as Cerebral Palsy, Intellectual Disability, Down Syndrome, Autism, among others. The population that attends the Educational Unit with Down Syndrome is 23 children in an age range of 4 to 9 years. Inclusion and exclusion criteria were applied respectively. It included participants with Moderate Down Syndrome and with a disability card endorsed by the CONADIS of 25-49%. The exclusion criteria included participants with multiple disabilities, those with a greater number of phalanges in their hands and those undergoing complementary therapies in other therapeutic centers. Of the 23 children with Down Syndrome, 5 present a percentage of disability greater than 49%. 6 participants attend physiotherapy in the afternoons in different health centers. Therefore, we worked with a sample of 12 children with moderate Down syndrome with their respective inclusion criteria and with a percentage of intellectual disability from 25% to 49% (CONADIS, 2022).

This project was carried out in the Specialized Educational Unit "Ambato", with the authorization of the Highest Institutional Authority. A previous explanation was given to the educational community about the benefits of the application of Multisensory Stimulation in users with different types of disabilities. (Huertas, 2009).

The population was selected taking into account the different exclusion and inclusion criteria. There was a socialization of the informed consent and acceptance of this project by the guardian of the minor. Two types of assessments were made. The first one consisted of a questionnaire with sociodemographic questions such as age, sex, percentage of disability and family context (with whom the minor lives and guardianship). The second part consisted of the application of an initial evaluation where a series of tests and scales were applied according to the needs of children with Down syndrome, followed by a post-evaluation (Basto et al., 2022).

In the sociodemographic data collection, different background of the participant with Down Syndrome such as age, sex, disability card, percentage of disability, as well as the data of his or her representative were recorded.

The search for solutions to the general problem was possible through the use of different tests and scales that supported the diagnosis and evaluation of the different problems presented by the children with Down Syndrome, especially in their psychomotor development. It gives way to the use of the Denver II Test, The Gesell Test of Geometric Figures, Goddard Test and the application of the assignment and calculation of the Fine Motor Development Coefficient. The application of the different instruments was supported by a consensus on the Technical Guidelines for the integral care of children under 10 years of age with Down syndrome (Ministry of Health, El Salvador). (Ministry of Health, El Salvador. 2019).

For the application of the different tests, the parameters of motor development of children with Down syndrome under 10 years of age were taken into account, observing an age gap of approximately 12 months in relation to a child without disability. Taking into account these data, the aforementioned instruments were applied with their respective modification (Ministerio de Salud, El Salvador. 2019).

The project had the criteria of a group of experts who provide their services in the Specialized Educational Unit "Ambato". It is made up of a Physical Therapist, a Speech Therapist, a Clinical Psychologist and a Medical Technologist of Rehabilitation and Physical Therapy. They were in charge of the review of each of the instruments applied in the participants with Down Syndrome. (San José & Asensio, 2020).

The Denver Scale or Test is a tool that provides a correct evaluation of the psychomotor development of the child up to six years of life. It was designed by several psychologists in order to analyze, observe and compare the maturation of the child through simple and recreational activities. It mainly examines four areas: Personal Social Area, Language Area, Fine and Gross Motor Area (Hervadas, 2020).

The application of the test is done through a table where the four areas to be assessed are located and their respective activities which range from zero months to 6 years, in which the child should be performing and fulfilling according to their motor development. The skills will be scored and placed according to their range of motor development. This scale will be performed under the supervision of three health professionals: Clinical Psychologist, Speech Therapist and Physical Therapist with the aim of obtaining the current values of psychomotor development. (Pérez et al., 2019) points out that the Denver Test has a specificity of 43 to 80%, while its reliability is 90% and exhibits easy application ranging from 80 to 95%.) The authors point out that the Denver Test presents a specificity of 43 to 80%, while its reliability is 90% and exhibits an

easy application ranging from 80 to 95%. On the other hand, the Gesell Test of Geometric Figures is an assessment instrument that provides the study of the child's motor development up to six years of age. Within this test, the Graphomotor aspect is located, which allows, through imitation and tracing, to observe the age of fine motor skills of the child to be evaluated. A sheet of paper containing different geometric figures is used. The shapes should be replicated in the shortest possible time by the child. His/her age range will depend on the highest number of correct answers. The graphs contained in the test are the circle, which corresponds to three year olds. The cross is equivalent to three and a half years old. The X is related to four year olds. The square is to five year olds. The inverted square is to six year olds. And the rhombus is to seven year olds. Bojórquez (2005) mentions that the Gesell Graphomotor Test presents a high reliability based on the test-retest approach with a Cronbach's alpha of 92% (p. 2-3). Conjointly, Cruz (2018) pointed out in his research work on Graphomotor skills and their development in pre-writing in boys/girls, about the validity, use of the Gesell Graphomotor Skills Scale and its incidence in the improvement of their fine motor skills yielding positive data. It means it reveals significant changes in fine motor skills.

As for the Assignment and Calculation of the Fine Motor Development Coefficient, the chronological age is considered together with the fine motor age to obtain the real mental age of the patient, which should be placed in months to obtain positive results. The GODDARD test is used for the measurement of manual skills, visual perception and visual-manual skills. It aims at the execution of different movements of the upper limbs in order to determine the psychomotor development of the child (Acosta et al., 2023).

The materials to be used are boards with ten geometric figures, pieces that must be placed outside the frame following a specific order. The first row with a rhombus, a star, and a circle. The second row with a square, a half-circle, an hexagon, and a cross. And the third row consisting of a rectangle, an oval and a triangle. (Machado et al., 2022).

The child puts the pieces in place with the dominant limb in the shortest possible time. The test will be repeated three times in order to choose the shortest time for the application of the respective formula and to get the correct psychomotor age. The experiment is performed three times and the time is registered with a stopwatch. The shortest turn will be chosen. The result is placed on a scale to get the psychomotor development. Then the formula is applied with the psychomotor age in months over the chronological age in months per hundred. In addition, Zapata (2018) points out that, through the research of his study on the different Graphomotor techniques for the stimulation of fine motor skills, the Goddard Test was applied in the pre and post stage of the research. It highlights positive and reliable results for the improvement and progress of motor skills in boys/girls (expert judgment). Multisensory Stimulation was developed through different rooms and activities that facilitated the awakening of different sensations by manipulating the oral, olfactory, gustatory and acoustic areas to achieve the restoration of fine motor skills. (Lotan & Merrick, 2004).

Twelve weeks of intervention were carried out, two weekly sessions, with a duration of forty minutes each therapy. Initially, each user with Down syndrome was assessed through the application of different questionnaires, scales and the respective activities within the study of Multisensory Stimulation (Cabrera & Dupeyrón, 2019).

The purpose was to observe, in a timely manner, the different deficiencies within the adaptive area of fine motor skills. The respective values were obtained, and it was proceeded to perform the therapy according to the needs of children within the adaptive skills of fine motor skills. Within the Multisensory Stimulation work. The direct interaction of the professional with the participant is important. That why two weekly sessions of forty minutes will be carried out. They will be individualized and the 6 children will be attended from 7:40 to 13:40 on Mondays and Wednesdays; while the other 6 children will be attended from 7:40 to 13:40 on Tuesdays and Thursdays. (Huertas, 2009)

At the beginning, the sociodemographic data was taken, where full names and surnames, sex, age, percentage of disability, place of residence, guardian's name, etc. were recorded.

The Denver Scale in Fine, Gross, Language and Social Adaptive Skills was applied. It will be structured by a Multidisciplinary Team that will be formed by the Physical Therapist, Language Therapist and Clinical Psychologist, in order to obtain the results of motor development in which the child is. (Gómez et al., 2017).

The Gesell Test of Geometric Figure was also applied. It helped to know the fine motor age of the child with Down Syndrome.

After obtaining the results of the different scales, we proceeded to the calculation of the development coefficient for fine motor skills. It was carried out as follows: Fine Motor Calculation CMF equals Fine Motor Calculation CMF times one hundred over the Chronological Age of the participant. All values will be entered in months. (Koller et al., 2018).

Once the fine motor age of the participant was known, we proceed to the comparison with the mental age vs. chronological age and the execution of the Multisensory Stimulation. (Molina & Colcha, 2019).

The application of the therapy was carried out in the Snoezelen Rooms (dark room), which was previously equipped

with the participant's needs.

The initial phase had a duration from ten to fifteen minutes' tops. It included the execution of soft and rhythmic massages.

The massages started with the legs, feet, trunk, arms, hands and ended with the face. And it should always be in an ascending manner.

As for proprioceptive work, which had a calm environment, the participant remained lying on soft mats while the professional proceeded to perform massages on his body rubbing on his hands with oils of delicate scents. The massage was applied in the upper body - remembering and repeating each part of his body while performing the massage.

The session was accompanied by soft, relaxing music, and a pleasant aroma. For the tactile zone different textures were used that came into contact with all portions of the body, especially in the hands. It included feathers, soft fabrics, hard, rough towels, sponges, brushes. It was carried out in an upward direction.

Massages were made, in an ascending direction, with balls that have different textures, rough sponges, soft fabrics, brushes.

The child was placed in front of the board of different textures where he/she manipulates each texture with the palm and back of the hands.

The participants were asked to pass several times over a dry shower (noodle curtain, sherbet curtain, paper curtain) to help stimulate their touch.

The use of the ball pool in the Snoezelen room was done in a progressive way. First, the participant was shown the pool, then he took the colored balls with his hands and finally he put his whole body in the pool.

Inside the ball pool, the participant was asked to take the different colored balls with his dominant hand and to throw them in different directions.

Different fine motor skills boards were used, so that they work only with their two thumb and index fingers to perform digital pincer. All this activity was performed with his dominant hand.

The participant was given different jars with grains and was told to classify them according to their size using his/her thumb and index finger.

The child was placed standing in front of the wall, with the help of lights of various colors and small balls. He was given the order to throw at a specific color that is reflected on the wall.

It is important to work on their vestibular system, for which the use of a swing, hammock was implemented. It made soft, rhythmic movements and they were told to raise their arms and lower them.

A seesaw was used while the professional made movements from left to right.

In a standing position, and jumping on the bouncer, the participants were asked to grab the balls thrown by the professional.

Pleasant music to stimulate the sense of hearing and pleasant smells to stimulate the sense of smell were applied.

At the end of the session, five minutes of relaxation were applied to return to reality. They chant a song, had a gentle massage and performed breathing exercises. (Quispe & Aronés,2014).

### **Statistical analysis:**

An efficient statistical analysis was handled to analyze the different data thrown. They were tabulated with the help of the Likert Scale and Excel programs by means of a file with a high security chain with password to safeguard the information of the different participants. In addition, the statistical test of T-Student was monopolized and served to compare two independent and small samples in the case of the population of the investigation. An efficient statistical analysis was performed. The different data obtained in the research were analyzed using SPSS Statistical Package for the Social Sciences version 20. This tool facilitated the correlation between the different variables, the level of significance of the samples obtained in the different tests, the validation of the hypothesis and the clarification of different statistical data.

### **Ethical Considerations:**

The current research had a review of a research protocol by the Ethics Committee for Research in Human Beings of the Faculty of Health Sciences of the Technical University of Ambato. It complies with all ethical, methodological and legal requirements established by the regulations of this Committee with approval code: **041-CEISH-UTA-2023**.

## RESULTS

The population intervened as a case study are children with a moderate level of disability which were evaluated by means of a Multisensory Stimulation strategy for fine motor skills in Down Syndrome in the Specialized Educational Unit "Ambato", Following the statistical data for the validation of the hypothesis:

### **Sociodemographic information**

The population under study consisted of a total of 12 students, 59% of whom were male and 41% female.

The students ranged in age from 4 to 9 years old, with a moderate level of disability (see Table 1).

**Table 1:** Sociodemographic Characteristics of the Research Population with Down Syndrome

Socio demographic factors	Quantity	Frequency	Percentage
<b>Genre</b>	Male	7	<b>59%</b>
	Female	5	<b>41%</b>
<b>Age</b>	4 -- 8	9	<b>75%</b>
	9 -- 12	3	<b>25%</b>
<b>% Disability</b>	20 -- 28	4	<b>33.3%</b>
	29 -- 37	7	<b>58.3%</b>
	38 -- 46	1	<b>8.3%</b>

**Note:** own elaboration with the research data (2024)

The demographic analysis of the students was based on the collection of relevant data such as gender, age and the level of disability of each of those involved for the analysis in the subsequent tests.

### **Initial analysis of fine motor data prior to stimulation**

The following results can be observed after the Denver Pretest. Graphomotor and Goddard tests were performed on the selected population (see tables 2 and 3).

**Table 2:** Pre-test Statistical Analysis of Fine Motor Skills (Graphomotor Skills, Denver)

		Statistics								
		Circle	Cross	X	Square	Inverted square	Rhombus	Grapho_Test	Denver_Test	Development Coef_pre
<b>N</b>	<b>Valid</b>	12	12	12	12	12	12	12	12	12
	<b>Mean</b>	1.83	1.83	1.92	2.08	1.92	1.92	20.50	18.75	27.04
	<b>Median</b>	1.50 <sup>a</sup>	1.67 <sup>a</sup>	1.71 <sup>a</sup>	1.67 <sup>a</sup>	1.56 <sup>a</sup>	1.57 <sup>a</sup>	16.67 <sup>a</sup>	15.00 <sup>a</sup>	22.33 <sup>a</sup>
	<b>Dev. Deviation</b>	1.403	1.586	1.505	1.443	1.311	1.621	10.992	10.323	11.338
	<b>Sum</b>	22	22	23	25	23	23	246	225	325

**Source:** Own elaboration with the research data (2024). Denver Test and Graphomotor skills

The Denver and Graphomotor Pre-Test were developed. It presented a standard deviation and variance, with a similar variability with respect to its mean. It had as data the Graphomotor test with a value of 10.9992 and Denver test with 10.323. This represents that the data were found further away from the mean, obtaining scattered data in each test.

**Table 3:** Statistical analysis of each student's pre- and post-test.

Name	Pre_Denver	Post_Denver	Pre_Grapho	Post_Grapho	Pre_D.C.	Post_D.C.	PRE_GD.	POST_GD
St1	4%	5%	5%	7%	7%	9%	14%	17%
St2	5%	6%	7%	10%	7%	8%	7%	12%
Est3	7%	7%	5%	7%	10%	11%	14%	17%
Est4	8%	9%	7%	10%	5%	6%	4%	4%
Est5	5%	7%	5%	7%	6%	7%	10%	11%
Est6	8%	10%	7%	10%	9%	10%	4%	8%
Est7	16%	17%	15%	16%	14%	14%	10%	11%
Est8	19%	20%	15%	16%	11%	10%	10%	12%
Est9	5%	6%	5%	7%	5%	6%	7%	12%
Est10	11%	21%	17%	17%	14%	17%	9%	11%
Est11	5%	7%	5%	7%	5%	6%	5%	8%
Est12	7%	8%	7%	10%	7%	8%	7%	12%

**Source:** Own elaboration with the research data (2024). Denver Test, Graphomotor (Grapho) test, Development Coefficient (DC) and Goddard (GD).

The Pre and Post Test of each of the 12 students' tabulated evaluations indicate significant improvement in each of the proposed items.

**Statistical analysis Post multisensory stimulation for fine motor skills**

As for the fine motor skills of each study subject, a notable improvement in the development of the activities proposed in each of the tests was found. It took into account normalized data for the validation of the hypothesis (see tables (4 and 5).

**Table 4:** Data Normality Analysis (Denver and Graphomotor)

Normality Tests							
	Sex	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
		Statistics	gl	Sig.	Statistics	gl	Sig.
Development Coef_pre	Female	.244	5	.200*	.823	5	.123
	Male	.270	7	.133	.916	7	.441
Development Coef_post	Female	.234	5	.200*	.910	5	.468
	Male	.163	7	.200*	.965	7	.858
Goddard Test pre	Female	.187	5	.200*	.974	5	.902
	Male	.213	7	.200*	.910	7	.395
Goddard Test post	Female	.298	5	.169	.913	5	.485
	Male	.244	7	.200*	.897	7	.314

**Source:** Own elaboration with the research data (2024). Denver and Graphomotor tests, SPSS

The normality analysis in the Denver and Graphomotor tests is validated by means of the Shapiro-Wilk test, with a sample no larger than 50 individuals. It takes into account the degrees of freedom ( $p \geq 0.05$ ) and acceptance of the H0 hypothesis that validates the improvement in fine motor skills.

**Hypothesis analysis and testing using Student's t-test**

This research consists of a probabilistic sampling of a Pre and Post tests on multisensory stimulation for fine motor skills in Down Syndrome in the Specialized Educational Unit "Ambato". The following results were obtained (see Table 5).

**Table 5:** Normalized Data

	Descriptive Statistics				
	N	Mean	Statistical	Statistical	
	Statistics	Statistics	Error Dev	Deviation	Variance
Denver, Grapho, brain perimeter pre	12	27.04	3.273	11.338	128.541
Denver, Grapho, brain perimeter post	12	30.15	3.116	10.794	116.503
Goddard pre	12	35.91	4.325	14.981	224.430
Goddard post	12	48.35	4.197	14.539	211.377
Valid N (by list)	12				

Source: Own elaboration with the research data (2024). Denver and Graphomotor tests, SPSS

The descriptive statistical data after the pre and post tests of the different methods used for the significant evaluation of each student indicate the following results: the post test has a value of 14.539 and the pre test 14.981. It shows that in the first one the data are not dispersed for a better decision making.

**Validation and Hypothesis**

Once the normality tests were carried out both in the pre and post test, we proceeded to validate the hypothesis with a significance level of 0.05. It resulted in the acceptance of the H0 hypothesis obtaining bilateral significance ( $p \geq 0.05$ ), and rejecting the alternative hypothesis (See Table 6).

Table 6 Hypothesis Analysis Paired Samples Testing

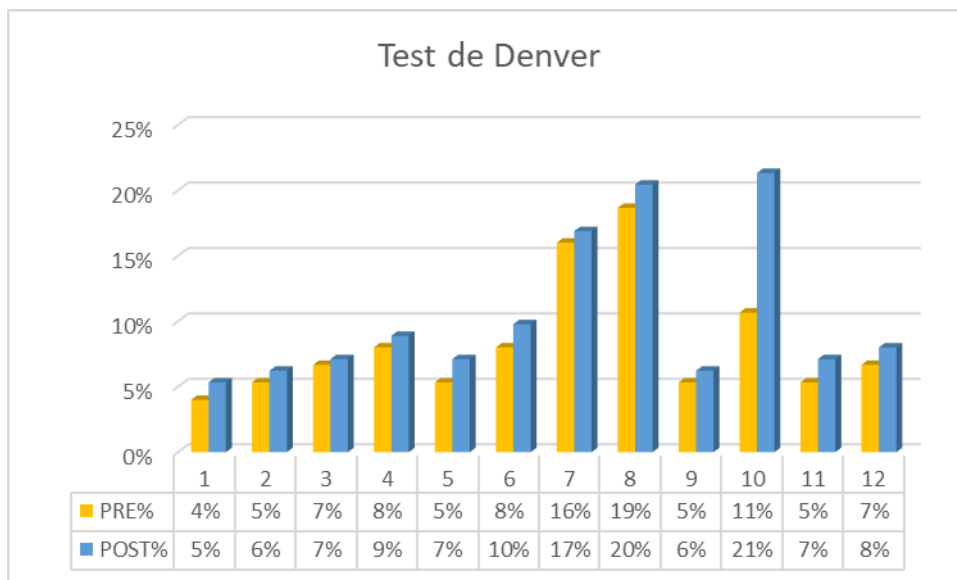
Paired Samples Test		Pair differences					t	gl	Sig. (bilateral)
		Mean	Dev. Deviation	Dev. Error average	95% confidence interval of the difference				
					Lower	Upper			
Par 1	Denver, grapho, brain perimeter pre - Goddard pre	-8.864	15.500	4.474	-18.712	.985	-1.981	11	.073
Par 2	Denver, grapho, brain perimeter post - Goddard post	-18.198	15.817	4.566	-28.248	-8.149	-3.986	11	.006

Source: Own elaboration with the research data (2024). Denver and Graphomotor tests, SPSS

The graph includes: analysis of the pre and post test data with their percentages (%) by groups, with description of means (M) and standard deviations (SD) of the post test variables, with significance analysis at a level of ( $p \geq 0.05$ ). A value of 0.007 and 0.006 was obtained.

Once the hypothesis H0 is accepted, we obtain that the Denver and Graphomotor test presents a significant degree of relevance in the conclusion of the hypothesis, being more reliable than Goddard (see graphs 1,2,3,4).

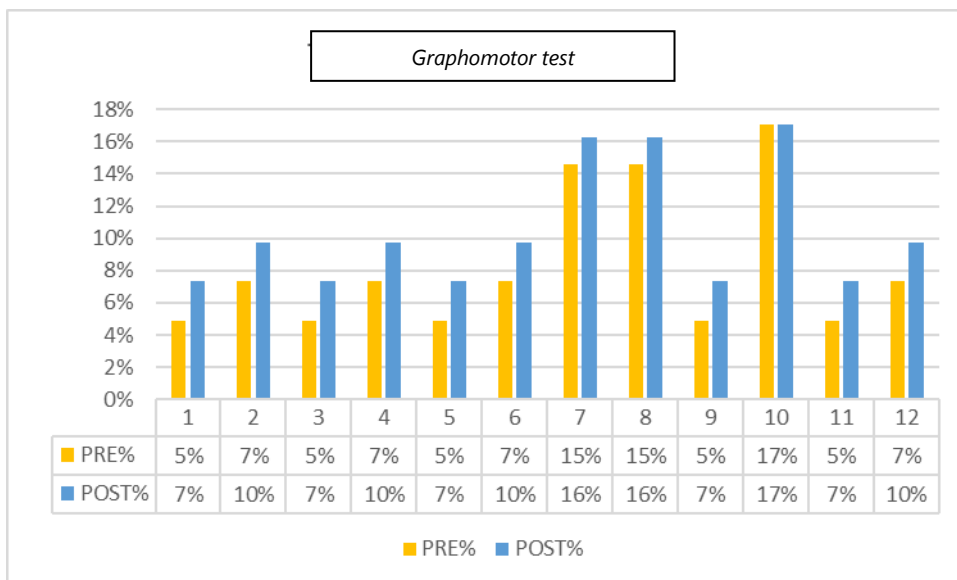
Graph 1 Pre y Post Denver Test



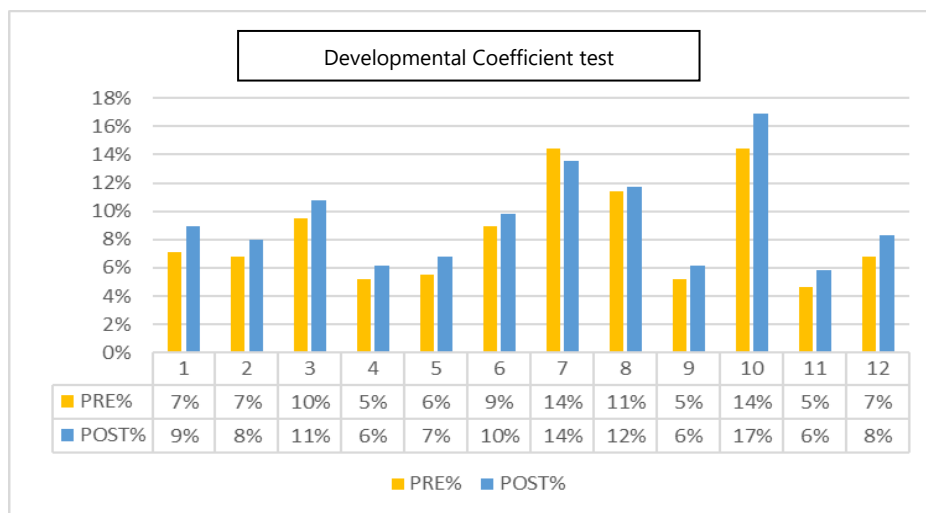
Source: Own elaboration with the research data (2024). Denver and Graphomotor tests



**Graph 2** Pre y Post Graphomotor test

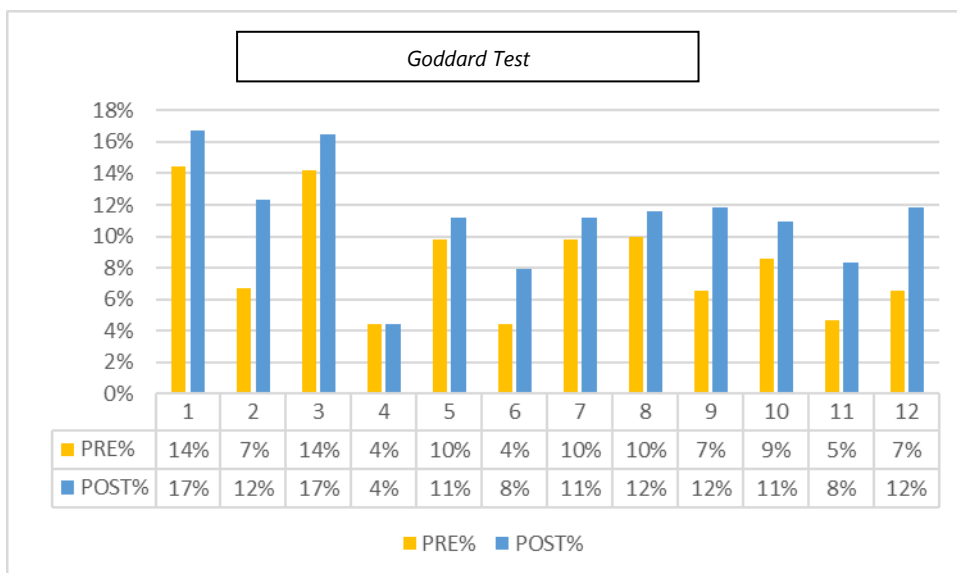


**Graph 3** Pre and Post Developmental Coefficient test



The denver test and graphomotor skills test show a significant improvement in the development of each proposed activity.

**Graph 4** Pre y Post Goddard Test



In relation to the Denver test and Graphomotor skills, the Goddard test considers an improvement in each of its tests. It assumes that the students, once they followed the stimulation methodology guide, have improved their fine motor skills, obtaining viable results to accept the hypothesis proposed.

## DISCUSSION

The current research work proved the effectiveness of the implementation of Multisensory Stimulation for fine motor skills in Down Syndrome in children from 4 to 9 years of age who attend the Specialized Educational Unit "Ambato" of the city with the same name. This was possible through the application of different tests, where several findings could be observed.

From the results obtained in the research it could be concluded that, when applying the evaluation instruments both pre and post, in the scales used such as Denver II, Gesell of Geometric Figures, Goddard and the Calculation of Fine Motor Skills there was a higher level of significance in the post tests. The Shapiro-Wilk test was applied where the hypothesis H0 was proved. The T-Student test allowed us to accept the H0 with an improvement in fine motor skills in each of the evaluation instruments applied.

On the other hand, in a study published in the scientific journal "Mundo de la Investigación y el Conocimiento" (Pérez et al.,2019) on the application of the Denver II test for the evaluation of child development, it is concluded that this test aims to determine the abilities of children based on the age in which they are. And this in turn, is an important tool in the early diagnosis of deficiencies in the evaluated child. The early approach to most child development problems significantly improves their prognosis. Therefore, the application of this type of test such as the DDST II allows the child who presents some developmental pathology to be treated early and increase their chances of having a better quality of life.

Finally, Troya and Arcos (2015) in their research on sensory stimulation in psychomotor development from 0 to 1 years of age in a child with Down Syndrome, conclude that the stimuli provided at early ages will favor the development and maturation of the nervous system. It is considered as the main system of activation of other psychomotor processes of the human being. Hence, it is essential to take advantage of brain plasticity with exercises that awaken the senses of infants. All knowledge enters through sight, hearing, taste, and touch. Its development is paramount.

## CONCLUSIONS

A Multisensory Stimulation Guide to improve fine motor skills in Down Syndrome was developed for the benefit of the educational community of the Specialized Educational Unit "Ambato".

The Multisensory Stimulation Guide to improve fine motor skills in Down Syndrome was qualified and evaluated by trained professionals.

The initial evaluation of fine motor skills in children with Down Syndrome reported a manual disability in all participants, while the results obtained after the implementation of the Multisensory Stimulation showed an improvement in fine motor skills in Down Syndrome.

The research allowed the development of a Multisensory Stimulation Guide to improve fine motor skills in Down Syndrome for the benefit of the educational community of the Specialized Educational Unit "Ambato"..

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